An Ecosystem Approach to Regional Habitat Management

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Introduction

The Southern California region is a complex ecological terrain, with considerable variations in ecology, land use and natural character. A research-based systems approach is proposed, which conceptualizes nature as being organized in a nested hierarchy, forming levels of organization, in which each level is emergent out of the interactions between its component sub-systems, and where these sub-systems are seen to be nested within their wider system. So, for instance, local jurisdictions can be seen to be nested as sub-systems within the system that is Southern California, which in turn is nested, along with other such regional systems, within the supra-system that is the State of California. Such a nested ecosystem approach would best serve to organize the ways in which regional, sub-regional and supra-regional plans and programs are seen to be integrated, and known to form and shape one another, across levels of organization.

Conventional approaches to habitat conservation have relied centrally on the designation of reserves exclusive of human use to support various endangered and threatened plant and animal species, in an effort to assure their long-term survival and recovery. A key model to consider, in assessing the diverse ways in which the region deals with Habitat and Natural Areas issues, is

the Habitat Conservation Plan (HCP) process, and also California's own Natural Community Conservation Plan (NCCP) process. Such HCPs and NCCPs are a vital component of regional ecological planning. However, recent developments in ecosystem ecology—such as patch dynamics and perturbation ecology—are showing that there are other sorts of interventions that can be used to support and reinforce the establishment of the more traditional set-aside reserves approach to conservation planning. In one sense, the call from contemporary ecosystem ecology *is to better integrate humans as components of ecosystems*, rather than relying on the separation of land uses for human and natural communities.

This approach is referred to as adaptive ecosystem management, and focuses on establishing protocols to assure the integrity of ecological processes and functions vital to the health and well-being of organisms and entities, including humans, within the region. Recognizing the inherent inter-dependence amongst components of the web of life and bio-geo-chemical processes that constitute nature, it becomes vital that we use just such a way of recognizing this nested inter-dependence in how we plan across levels of ecosystem organization.

A central element to such an approach to ecosystem management is the percolation of native habitats and landscape elements into urban and sub-urban cores. An emphasis on ecologically appropriate community forestry, coupled with efforts to promote and establish the widespread use of native vegetation (xeriscape, in the case of Southern California), would go a long way to restoring

the ecological mosaic that would more effectively support the ecosystem health of areas set aside for nature, while at the same time increasing the resilience of regional topographies. Relatedly, the propagation of surfaces porous to storm and rain water, to replace the vast and sprawling tracts of impervious surfaces that human habitation is accustomed to laying down, would puncture the land, permitting improved ground-water recharge, better storm-water management, enhanced health in soils, and better integration across land uses in how natural habitats are integrated at the microbial and geo-chemical process-function levels.

Conventional concerns with set-aside nature reserves for habitat are most effective when integrated with the percolation of natural habitat elements such as native landscaping and species-selective tree plantation initiatives, and with the puncturing of the acres of impervious pavements we conventionally rest our settlements upon.

Integrative Ecosystem Approach to Habitat and Natural Areas Planning In Southern California: Proposal for An Urban Ecology-based Set of Regional-level Interventions

An ecosystem approach to regional environmental planning allows the use of nested scale hierarchies in generating rich descriptions of the urbanizing Southern California landscape. A key concept in such a systems approach is the notion of levels of organization—where any purposively named system is conceived as being emergent from the functional interactions of its constituent sub-systems, and where each such system is, in its own turn, seen to be in

relational association with other commensurate systems at its own level of organization, giving rise to a wider supra-system, and so on. Such a nested structure shows, for instance, development projects interacting to give rise to neighborhoods, and neighborhoods interacting to give rise to cities, and cities giving rise to counties, and counties to regions.

This idea of levels of organization allows us to conceptualize the planning domain as being constituted by functionally relevant intervention layers, each with its own particular set of scales. Then, regional, sub-regional (city- and county-level) and local (project-level) interventions can be conceptualized in some integrated fashion, where each level supports and enhances the effectiveness of the others. The implementation of such a coherent, nested system of integrative regional planning approach would allow much of the cumulative environmental impact analysis and the mitigation management system required for project-level environmental analysis to be more effectively attributed to the regional level, allowing projects to concentrate on the directly local impacts.

An integrative set of interventions, using vernacular urban forestry, native vegetation (xeriscape), impervious surface mitigation, and albedo modification techniques can then be proposed as a holistic strategy with habitat, hydrology, heat island and air pollution improvement benefits cumulatively accruing. A research-based approach to planning in the model of adaptive ecosystem management that aims to capture and present the cumulative benefits of such an integrative ecosystem approach to urban ecology then shows significantly

greater benefits than might be thought to accrue from a more piece-meal and arithmetically additive approach.

Such a meta-project ecosystem approach to integrative regional planning focuses on some key aspects of the planning domain:

- First, when landscape-level habitat elements are percolated into the urban environment, they add resilience to existing and proposed networks of set-aside habitat reserves for threatened and endangered species (the strategic, region-wide propagation of native plants and suitable tree species, for instance, as well as stream restoration and the introduction of porous paving surfaces would be specific strategies in such an habitat percolation approach);
- Second, and relatedly, such a percolation of habitat elements would as well significantly improve community livability at the local level, by intentionally integrating human settlements with nature and aesthetically enhancing the urban fabric in a manner that self-consciously improves habitat connectivity and reinforces wildlife corridor plans taking shape within the region;
- Third, the hydrological performance of the urban landscape can be substantially improved by the judicious use of urban forestry and landscape modification (stormwater run-off and pollution mitigation, for instance, and enhanced groundwater recharge would be some of the key benefits).

- Fourth, the energy performance of urban and suburban landscapes can be markedly improved by the strategic placement of trees and vegetation surfaces throughout the urban ecosystem (besides reducing local energy needs, the urban heat island mitigation effect can itself be significant).
- Fifth, the urban and air pollution control capabilities of the region could be substantially increased by the judicious use of tree plantations around key transportation corridors would buffer communities from noise and particulate pollution (in addition, the propagation of tree-planting and landscaping in urban surface parking lots and car dealerships would measurably reduce the release of volatile organic compounds from the fuel systems of parked vehicles that would otherwise bake in the sun).

Such an ecosystem approach to habitat and natural areas planning requires the assembly of a multi-criteria description of such an ecological approach that is persuasive to local decision makers (elected officials and city and county planners, for instance) in showing the cumulative benefits of such an integrated approach to environmental planning. An enumeration of the socio-economic and environmental benefits based on such a description would be of significant benefit to the regional planning domain.

Action Plan: Factors in A Watershed-based Habitat and Open-space Landscape Element (WHOLE) Systems Approach to Regional Environmental Planning

The use of interventions based on urban forestry, native vegetation, and impervious surface mitigation form the basis for such a Whole-systems approach to regional environmental planning. Key elements in such an approach are:

- Habitat enhancement;
- Hydrology management;
- Heat island mitigation;
- Air and water pollution control; and
- Wildfire management

Habitat Enhancement:

Conventional approaches to habitat conservation, even in their innovative forms (such as California's Natural Community Conservation Program, or the NCCP), are based on the Endangered Species Act. As a consequence of the central concern with setting aside designated "critical habitat" sufficient to ensure population viability, set-asides of land based on reserve design have become the traditional concern. Such set-aside reserves are crucial to the success of our efforts to conserve and restore natural ecosystems to some reasonably healthy state.

However, set-aside reserves alone cannot be the whole answer. Nor can our current and almost exclusive focus on organismic life-forms—those plant and animal species most directly accessible to our sense of sight—be a sufficient basis for ensuring healthy ecosystem functioning. Indeed, if ecosystem ecology

has shown us anything, it is that nature is constituted first by the processes and functions—the exchanges of matter, energy and information—from which organisms are emergent.

Nor can we simply divide our inhabited landscapes into lands that have been allocated to nature and lands that we have deemed for our own use. A resilient ecosystem requires that humans and human activity be better integrated into nature. Encouraging landscape elements that reinforce native ecosystem processes must become central to how urban ecology is practiced in regional environmental planning, in combination with a supra-regional approach to planning and evaluating wildlife habitat connectivity.

- Encourage use of native vegetation (xeriscape)
- Create incentives for urban forestry
- Stream restoration
- Soil ecology and microbial health
- Create regional assessment of gaps in habitat connectivity, wildlife corridors (Ventura County, Chino Hills/Puente Hills, Riverside Integrated Plan)

<u>Hydrology Management:</u>

Probably the single most dramatic ecological impact of urbanization and development is generated by the wide-spread propagation of impervious surfaces around human habitation. When coupled with the imperative to move

rain and storm water away from such habitation with the extensive use of storm water drainage systems, the cumulative impacts on the contextual ecosystem become significant. Not only is natural ground water recharge adversely impacted by such conventional flood-control interventions, but a whole host of ecological processes and functions are disrupted as well.

There is clear evidence that it need not be so. Efforts such as Low Impact Development (LID), which seek to use nature to reinforce nature—by puncturing impervious surfaces to allow ground water recharge, encouraging urban forestry to locally capture rain and storm waters in their root systems, percolating urban runoff waters into living soils so as to allow microbial action to help remove many of the pollutants that coat our roads, driveways and often synthetically maintained lawns—can all cumulatively help to ecologize the urban landscape.

By the nature of their use by automobiles, roads and driveways are usually coated with toxic particulates deposited from vehicle exhausts and engine drips. In Southern California, such toxic coatings are allowed to build up over significant periods of time, because the region receives only infrequent rain, and that heavily compressed into a few weeks of winter downpour. As such, when it does rain, almost a year's worth of deposits are collectively flushed off the roads and driveways by a few days worth of annual rainfall. The infrequency of such rain, when coupled with its intensity, creates significant ecological pressures on the regional ecosystems, and mitigation becomes all the more imperative.

- Impervious surface mitigation measures, to improve stormwater management and groundwater recharge

- Species-strategic urban forestry, to improve stormwater management by enhancing the catchment properties of soils due to tree root systems; and
- Urban runoff pollution remediation using phytoremediation techniques
- Stream and wetland restoration, to increase the dwell-time of run-off rainfall and storm waters upon the soil.

Heat Island Mitigation:

It has long been recognized that urbanized areas tend to be 2-10 degrees Fahrenheit hotter than the surrounding country-side. This is referred to as the "urban heat island" effect, which is due in large part to the locally concentrated increases in solar heat absorptive surfaces such as dark roofs and pavement that accompany urbanization. Two significant consequences of this increased local temperature, particularly during summer months, are an increased load on the electrical energy network due to the greater demand for indoor air conditioning, and an increase in the formation of tropospheric ozone, or smog. Smog-formation is a temperature-sensitive photochemical reaction that occurs when volatile organic gases and oxides of nitrogen emitted by vehicles and other human activities interact in the presence of sunlight to generate ozone. The strategic use of trees and landscaping as heat island mitigation both reduces the demand on the regional energy network and at the same time reduces smog-formation, without any physical decrease in the volume of automobile exhausts emitted.

What makes such a set of interventions particularly desirable within an ecosystem approach is the fact that, in addition to these two direct and substantial benefits, the urban forestry and landscaping interventions so activated have significant additional benefits: in storm water management, by capturing rain and storm water in leaves and root systems; in ground water recharge, by puncturing otherwise impervious surfaces so as to allow better connectivity between water flows and soils; in habitat enhancement, by percolating natural landscape elements into an otherwise wildlife-unfriendly urban topography; in particulate air pollution reduction, by the fact that leaf-surfaces effectively trap many of these often toxic dust particles emitted by vehicular exhaust; and in aesthetic improvements, by introducing trees and parklands into urbanized communities. The diverse and ecologically considerable cumulative benefits of heat island mitigation measures make them particularly cost-effective in terms of the consequent services allowed to be provided by nature.

- Modification of heat-absorptive properties of horizontal surfaces (roofs, roads and parking surfaces) by changing materials and colors; and
- Species-appropriate urban forestry and vegetative landscaping to increase shading and to reduce ambient heat absorption.

Air and Water Pollution Control:

Urban habitat and natural areas planning, in its introduction of trees and vegetation, has a number of pollution mitigating benefits as well. Beside the air

pollution control effects of tree-plantation discussed above—reductions in ozone formation due to reductions in ambient temperatures, reductions in evaporative volatile organic gases due to increased shading of parked vehicles, and the increased entrapment of toxic vehicular exhaust particles by leaves—there are a number of storm water and urban runoff pollution mitigation benefits as well. The root systems of trees contain and slow down the movement of runoff through the soil, giving microbial action more time to effectively alleviate some forms of pollution. And the strategic planting of particular sorts of vegetation can be use to phytoremediate at least some of the toxic materials flushed off roads and paving by rainfall.

- Strategic tree-plantation corridors alongside key transportation and trucking routes, and around stationary sources of particulate pollution
- Appropriate vegetation for phytoremediation alongside roads and highways

<u>Wildfire Management:</u>

It has been noted that the steady encroachment of urban development onto otherwise natural wilderness areas has increased the urban-wildland interface, and thus brought humans into more direct contact with ecosystem processes such as wildfire, which, though necessary and even desirable in the wilderness, pose a significant threat to human habitation. Research is beginning to show that strategic selection of tree and plant species, and the effective management

of landscape elements can very substantially mitigate some of the wildfire dangers inherent in the urban-wildland interface.

- Fire-savvy species selection in trees and vegetation
- Landscape control around urbanized areas